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THE AMDERMA FLUORSPAR DEPOSIT IN THE USSR

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The Amderma fluorspar deposit is located in the northwest portion of Yugorskiy Poluostrov (peninsula), near the coast of the Kara Sea. The "Amderma" Mine is situated in the northern part of this area, near the mouth of the Amderma River and 33 kilometers east of the arctic station "Yugorskiy Shar." The coordinates of the Amderma fluorspar deposit at the mine location are 69 45 N and 61 40 E. The Amderma settlement is on the coast of the Kara Sea, 1.5 kilometers from the mine, and is connected with the mine by a stone-paved road.

Amderma is connected by sea routes with Arkhangel'sk and Murmansk. The sea routes cross the southwest part of the Kara Sea, pass through Yugorskiy Proliv (strait) into the Barents Sea, where they branch out in two directions. The northern route to Murmansk goes through the Barents Sea and the Kola Fiord, and the southern route to Arkhangel'sk passes through the Barents Sea, the White Sea, and the mouth of the Severnaya Dvina River. The sea route is more convenient both for passenger and freight transport, as it is less expensive than land transportation.

The region surrounding the fluorspar deposit is a marshy, slightly undulating tundra with a large number of lakes. The Amderma deposit is located on a number of ridges, numbered 1 to 7, beginning at the coast and gradually increasing in height in a south-southeast direction; ridge No 1 reaches a height of 19.7 meters and ridge No 7 a height of 54 meters above sea level. The "Amderma" Mine is located on ridges No 2 and 3. The Amderma River separates ridges No 1, 2 and 3 on the right river bank from ridges 4, 5, 6 and 7 on the left bank. The maximum width of the river valley is 400 meters.

The Amderma deposit, which was discovered in 1932, extends over an area of about 28 kilometers, from the mouth of the Amderma River in a south-southeast direction on the Yugorskiy Poluostrov.

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Between 1933 and 1937, 207 drill holes with an average depth of 80-90 meters were drilled by prospecting parties in this location. The maximum depth of a drill hole was 250 meters (hole No 97) and the minimum depth was 28.1 meters (hole No 7). Most of the drill holes, or a total of 180, are found in the area of ridges 1, 2 and 3. Ridge No 2, which has been drilled to a depth of 100 meters, has four levels of underground mine workings and has been considerably explored. Ridge No 3 has been less explored and only a small portion of it is being worked by underground shafts. Ridge No 1 has been insufficiently explored.

The basic raw material found in the Amderma deposit is flotation fluorite ore; the reserves of this ore are sufficiently large to make this one of the most important deposits in the USSR.

The Amderma deposit includes three basic types of ore: fluorspar sulfide ore, ore breccia, and fluoritized limestone. The mineralogical composition of fluorspar sulfide ore is: fluorite, quartz, calcite, sphalerite, chalcopyrite, and pyrite. The dominating component of the ore is fluorite in the form of large crystallic or granular, semitransparent aggregates of a light blue, light violet, clear white, or dull white color. The high quality of this ore has made it the main object of industrial exploitation on all mining levels, mainly in the area of ridges 2 and 3. The other two types of ore, ore breccia and fluoritized limestone, contain a lower percentage of fluorite.

Fluorspar sulfide ore contains more than 80 percent fluorite and forms ore pockets and veins of various sizes. The following table shows the chemical composition of different types of fluorspar ore.

No of Chem Analyses	Type of Rock	CaF_2	SiO_2	Al_2O_3	Fe_2O_3	$CaCO_3$	$MgCO_3$	Fe	Pb	S	Cu	Ni
17096*	Dark violet fluorite	80.14	16.72	--	--	2.36	--	0.47	--	0.39	--	Traces
1647	Same	99.17	0.25	--	--	--	--	--	--	--	--	--
13651	Pale violet fluorite	99.5	0.96	--	--	1.69	Traces	0.56	--	--	--	--
1645	Same	99.95	0.04	--	--	--	--	--	--	--	--	--
13652	Light blue fluorite	96.1	0.76	--	--	1.69	Traces	0.55	--	--	--	--
1646	Same	99.51	0.14	--	--	--	--	--	--	--	--	--
13649	Dull white fluorite	96.3	0.44	2.08		1.41	--	0.39	--	0.43	--	--
1644	Same	99.33	0.23	--	--	--	--	--	--	--	--	--
13653	Colorless (white) fluorite	97.6	1.80	--	0.39	1.69	--	--	--	--	--	--
12414	Pure white fluorite	98.7	1.31	0.27		0.38		0.02	--	--	Traces	--

* Chemical analysis No 17096 disclosed traces of nickel, quite probably due to the inclusion of pyrite.

The question as to which type of ore may be considered industrial ore was frequently debated and a decision was reached in 1935 at a joint technical conference of representatives of the Vaygach Mining Trust of the Main Administration of the Northern Sea Route, the State Institute for Planning Mining Enterprises, and the Scientific Research Institute of Machine Processing of Minerals.

The ore mined at present is subdivided, according to its concentration method, into high-grade (shtufnaya) ore, "screen" (sitovaya) ore, and flotation ore. High-grade ore, which contains more than 80 percent CaF_2, is mined from pockets of pure fluorspar. As a result of manual ore sorting, an industrial type of ore is obtained which contains over 95 percent CaF_2, i.e., superior to the highest grade of the all-Union standard. In Amderma this type of ore is called "extra."

"Screen" ore, which contains 65-80 percent CaF_2, represents concretions of pure fluorspar with fluoritized limestone or veinstone, as well as fine veins of pure fluorspar. The sorting of this type of ore is done by machine. Flotation ore, which is not suitable for concentration by hand, represents limestone in various stages of metasomatism (fluoritized limestone) with an average CaF_2 content of not less than 40 percent (the lowest limit of CaF_2 content for ores included in the computation of reserves is 20 percent).

In estimating the reserves of flotation ore, consideration was given to the ore quality and the thickness of ore beds. As far as thickness was concerned, ore beds of 0.75 meter and more were considered, those between 0.75 and 1.5 meters being placed in a special category; the lowest limit of CaF_2 content was determined as 30 percent. As shown by calculations, the average CaF_2 content of this ore is assumed to be 40 percent. An average ore sample (gross sampling) had the following content: 40 percent CaF_2 and 28.9 percent SiO_2. The average chemical composition of flotation ore after sorting was as follows: CaF_2, 47.5 percent; SiO_2, 30.8 percent; $CaCO_3$, 19.1 percent; $MgCO_3$, 0.9 percent; Fe, 2.1 percent; Cu, traces; S, 2.9 percent; and K_2O, traces. Results of concentrating an average ore sample proved that by simple hand picking of rock the CaF_2 content in the ore can be raised from 40 to 47 percent. These facts showed that for flotation purposes it was possible to use ore containing less than 30 percent CaF_2, as long as the resulting product contained not less than 40 percent CaF_2.

As a result of computations made at the Amderma deposit (on the basis of materials of the Vaygach Mining Trust), the total reserves in 1937 were estimated as follows (in tons):

Ridge No	Category A_2	Category B	Chem Comp CaF_2	Chem Comp SiO_2	Category C_1	Chem Comp CaF_2	Chem Comp SiO_2
1	--	--	*	--	748,000	40.7	31.6
2	11,000	588,000	49.2	29.9	195,000	34.1	31.2
3	--	308,000	40.1	30.0	250,000	46.7	31.5
Total	11,000 /sic/	896,000	46.0	29.8	1,193,000	41.0	31.0
Including reserves confirmed by the Central Commission on 19 Jan 1936	55,000	519,000			460,000		

* /Figure illegible; possibly should be 48.7/

The total reserves of fluorspar ore for all three ridges and for categories A_2, B, and C_1 thus amount to 2,100,000 tons. Nonindustrial ore reserves (ore not suitable for exploitation under present economic conditions) have been estimated at 945,000 tons.

On the basis of prospecting work done on the first five ridges, ore reserves in category C_2 have been estimated at 535,000 tons. The CaF_2 content in this type of ore exceeds 30 percent. The reserves of high-grade ore, or commercial fluorspar, have not been computed.

The reserves, even though they have been computed for only a portion of the entire deposit, make the deposit one of the largest in the USSR. However, these reserves do not exhaust all possibilities of the deposit even on the first three ridges. Continued research and prospecting in the remaining part of the deposit will doubtlessly increase the amount of total reserves.

The flotation of fluorite ore with sea water has given entirely satisfactory results.

In addition to fluorspar, the Amderma ores contain an average of less than one percent zinc. Therefore, in selective flotation it would be practical to float the zinc first, and then the fluorite.

The concentration plant to be built in Amderma is to have a productivity of 5,000-7,000 tons of fluorspar concentrate a year, which would require about 14,000-18,000 tons of ore. Consequently, this enterprise would have sufficient ore reserves for at least 100 years.

In addition to an annual output of 5,000-7,000 tons of fluorspar concentrate, a certain amount of zinc may be obtained as a supplementary product. This would increase the value of the Amderma deposit. After construction of the concentration plant has been completed, the Amderma deposit will occupy a leading position in the USSR because of its favorable location in relation to consuming centers and the high quality of the commercial product which is to be produced (for the chemical industry).

The general economic conditions in Amderma are favorable for the development of industrial enterprises in this location. The favorable topography and the presence of water, necessary for the concentration plant, as well as the vicinity of a fuel (coal) base, located 60 kilometers east of Amderma, facilitate the organization of this enterprise.

It should be pointed out that of the total amount of ore reserves in all categories, the Central Commission of Reserves has confirmed only 1,034,000 tons. The confirmed ore reserves in category A_2 totaling 55,000 tons are insignificant and have been partially mined. Therefore, despite the considerable amount of prospecting completed so far, the Amderma deposit has not yet been sufficiently explored and should be given much more attention by geological prospecting organizations.

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